

Abstract

A system for measuring plasma electron densities (e.g., in the range of 10^{10} to 10^{12} cm⁻³) and for controlling a plasma generator. Measurement of the plasma electron density is used as part of a feedback control in plasma-assisted processes, such as depositions or etches. Both the plasma measurement method and system generate a control voltage that in turn controls the plasma generator. A programmable frequency source sequentially excites a number of the resonant modes of an open resonator placed within the plasma processing apparatus. The resonant frequencies of the resonant modes depend on the plasma electron density in the space between the reflectors of the open resonator. The apparatus automatically determines the increase in the resonant frequency of an arbitrarily chosen resonant mode of the open resonator due to the introduction of a plasma and compares that measured frequency to data previously entered. The comparison is by any one of (1) dedicated circuitry, (2) a digital signal processor, and (3) a specially programmed general purpose computer. The comparator calculates a control signal which is used to modify the power output of the plasma generator as necessary to achieve the desired plasma electron density.